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Establishment of an Effective and Cost-efficient means of Communication in the Advent of a Disaster

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***Abstract*— Since times, disasters have been classified as mainly by two types: Natural and Man-made. Recently, In 2011 Japan faced a tragedy where natural disasters (tsunami, earthquakes) were accompanied by man-made disasters (nuclear radiation emitted by damaged nuclear reactors).It was found that, man-made disasters could be prevented whereas natural disasters could be controlled. But when a diabolical disaster strikes without a warning, communication plays a vital role in survival. With the help of communication, the emergency disaster service team can be contacted and alerted the whereabouts of the casualties. In order to know the whereabouts of the casualties we have various working systems like mobiles, internet, etc. But what if disasters like cyclones, earthquakes effect communication by disrupting the antenna which is a primary source for mobile communication? So here comes an oldest mode of communication Home Amateur Radio (HAM) which is still the superlative choice. Amateur radios come in handy in such dire situations. This paper deals with the making of a homemade amateur radio that can be built using the simplest and commonly found electronic equipments available and the communication procedures regarding the transmission and reception of various signals. These hams hold a major advantage over other communication systems as they are easily made, low cost and portable in nature. It is essential for a portable and light weight means of communication during repercussion of a disaster as it quickens the pace for travelling. These hams are allocated with certain frequencies which help in communicating with the outside world. The homemade radios have become essential now for people belonging to every sector of the society as it helps them to gain both technical knowledge and a medium for maintaining amiable social relationships.**

Keywords— *HAM, Communication, Radio*

I. INTRODUCTION

Disaster is an unpredictable phenomenon which causes damage to nature and livelihood. A disaster is mainly caused due to two factors: Man-made and Natural. In advent of a disaster which may be either natural or man—made communication plays a vital role in analysing the situation, alerting and to execute rescue operations.

Communication serves the purpose of transferring information from one user to another user. It requires:

1. Source (Transmitter)
2. Destination (Receiver)
3. Channel and
4. Signal

Signal contains the required message which is to be transmitted from the source and received at the destination via a channel. A channel can be wired or wireless, but during a disaster various wired connections can be interrupted and thus are inefficient. Wireless communication uses free space which is inexpensive and prima facie for effective communication.

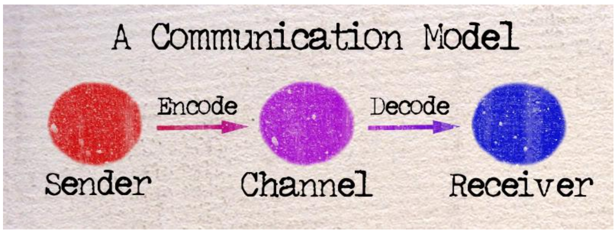


Figure 1. A Communication Model

The main accomplishment of wireless communication is that it changed the globe into a village. The main form of the wireless communication started with telegraphy using a universal code known as Morse code. Later this wireless communication ventured into Radio invented by H. Hertz. HAM Radio is one such form of it apart from being the oldest invented by G. Marconi. Even though it is the oldest it is worth its salt. HAM is an informal term for an amateur radio operator, and, by extension, "HAM RADIO" refers to “AMATEUR RADIO” in general.

Figure 2. Wireless Radio

Figure 3. HAM Radio

II. WORKING AND OPERATION OF HAM RADIO

Amateur Radio contain mainly of two blocks: Transmitting block & Receiving block.

A. Transmitting Block contains:

1. **Oscillator** to generate oscillations at certain frequency which is used at low voltage and current.
2. **Buffer amplifier** to amplify output signal which in turn used to multiply oscillator frequency.
3. **Radio Frequency Amplifier** which is used to bring RF signal to Arial loading which is set in optimum modulated conditions.
4. **Modulator** to produce audio power which modulates RF at output stage.
5. **Mike Pre Amplifier** to amplify mike voltage and to provide sufficient power for negative feedback.
6. **Mike** for receiving the input signal (i.e. the voice input)
7. **Antenna** for transmitting the signals.

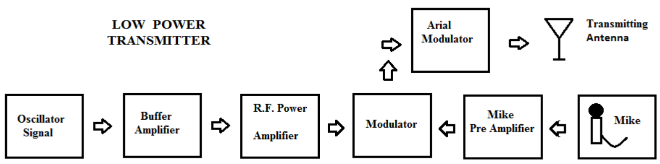


Figure 4. Transmission Block

B. Receiving Block contains:

1. **Antenna** for receiving transmitted signal.
2. **Radio Frequency Amplifier** to amplify the incoming R.F signal.
3. **Mixer** to mix the signals received from R.F stage and Heterodyne Oscillator to form Intermediate Signal (I.F signal).
4. **Heterodyne Oscillator** provides locally generated R.F signals and also amplifies it some extent.
5. **Intermediate Frequency Amplifier** to amplify the received I.F signal to a fixed frequency.
6. **Detector** to separate intelligence conveyed by the I.F signal from the carrier and controls R.F gain.
7. **Beat Frequency Oscillator (B.F.O)** which enables reception of a carrier wave telegraphy signal clearly and operates at slight different frequency.
8. **Audio Frequency Amplifier** to amplify voltage for audio signals.
9. **Loud speaker** for receiving the amplified signal.

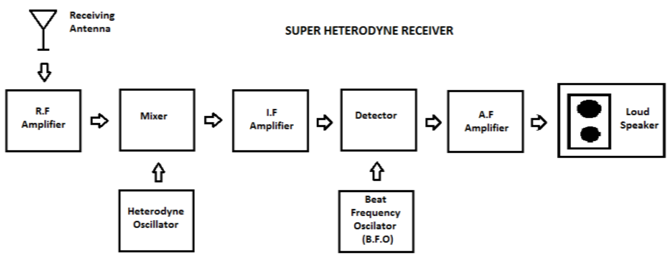


Figure 5. Reception Block

III. HOW TO BUILD A LOW POWER TRANSMITTER

Figure, below, shows the connections you need to make to build the circuit. The transformer isolates the music player from the rest of the circuit, couples the music player and the crystal oscillatory, and "steps up" the signal voltage from the music player in proportion to the ratio of 1 kohm to 8 ohms. The stepped up signal from the secondary coil of the transformer modulates the power to the oscillator chip (+ power at pin 14 and − power at pin 7). A wire connected to the oscillator output (pin 8) serves as the antenna for broadcasting the amplitude-modulated radio wave.

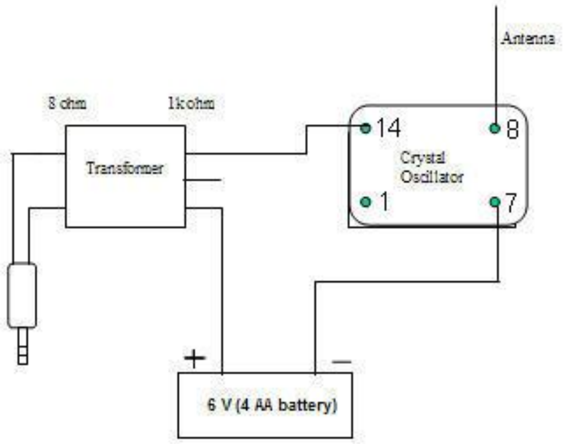


Figure 6. Simple AM transmitter circuit diagram. The square corner of the oscillator corresponds to pin 1. The pins are numbered according to standard positions for a 14-pin integrated circuit.

Figure 7, below shows a small breadboard. The breadboard has a series of holes, each containing an electrical contact. Holes in the same column (examples highlighted in yellow and green) are electrically connected. When you insert wires into the holes in the same column, the wires are electrically connected. The gap (highlighted in orange) marks a boundary between the electrical connections. A wire inserted in one of the green holes would *not* be connected to a wire inserted in one of the yellow holes. Integrated circuits, such as the oscillator used in this project, should be inserted so that they span the gap in the breadboard.

That way, the top row of pins is connected to one set of holes, and the bottom row of pins is connected to another set of holes. If the integrated circuit was not spanning a gap in the

breadboard, the pins from the two rows would be connected together (shorted), and the integrated circuit wouldn't work. Finally, the two single rows of holes at the top and bottom (highlighted in red and blue) are power buses.

All of the red holes are electrically connected and all of the blue holes are electrically connected. These come in handy for more complicated circuits with multiple components that need to be connected to the power supply. If you have never used a breadboard before you may want to take a look at a beginning breadboard activity, Electronics Primer: Use a Breadboard to Build and Test a Simple Circuit, before you start this science project.

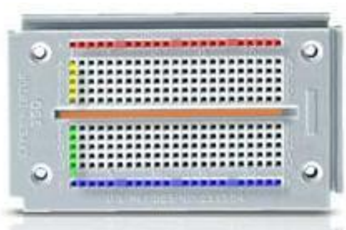


Figure 7. An example of a solder-less breadboard.

The highlighting shows how the sets of holes are electrically connected. The red and blue rows are power buses. The yellow and green columns are for making connections between components. Integrated circuits are inserted to span the gap (orange) so that the two rows of pins are not connected to each other.

1. Connect the terminals of the phone plug to the 8 ohm side of the transformer. You can either use alligator clips or a soldering iron to do this. See below for an example. Note: in the kit, alligator clips are used rather than soldering.

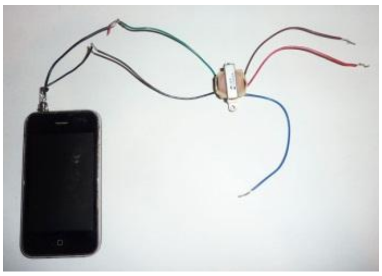


Figure 8. The terminals of the phone plug should be connected to the 8 ohm side of the transformer either by soldering or using alligator clips. In this picture the phone plug has also been plugged in to an iPod. The iPod serves as a music source.

2. Insert the 1 MHz oscillator across the gap in the breadboard, so that pins 1 and 7 are on one side of the gap, and pins 8 and 14 are on the other. You can identify pin 1 of the oscillator because it is next to the square corner (the other three corners are rounded). Be careful not to bend the pins.

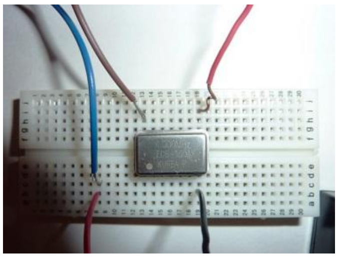


Figure 9. 1MHz Oscillator with connections on the breadboard

3. The breadboard to connect the positive and negative terminals of the battery holder and the 1000 ohm side of the transformer as shown in the diagram and in Figure below. Note that the 1000 ohm side of the transformer has a centre tap which is not used in this project.

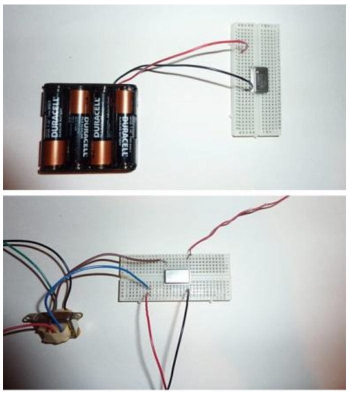


Figure 10. The positive and negative terminals of the battery holder are connected to the breadboard (top). Then the 1000 ohm side of the transformer is wired into the breadboard and the antenna jumper wire is added (bottom).

4. Connect a long jumper wire to the output of the crystal oscillator (pin 8). This will serve as the antenna. See Figure above.

5. Double-check to make sure that all of your connections correspond to the circuit diagram.

6. Figure, below, shows a photograph of the completed setup including an iPod for generating the music and an AM radio receiving the signal.

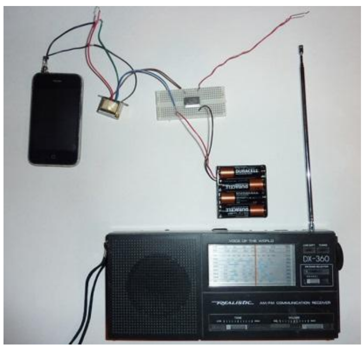


Figure 11. The completed circuit looks like this. In order to test the circuit you will need to connect the phone plug to a music source, for example an iPod as shown here, and use an AM radio to receive the signal

IV. COMMUNICATION PROCEDURE

The transmission must be made in plain language and must be short to save time. When regular telecommunication systems fail during natural calamities, Radio Amateurs are given access to receive message from third party. This communication must be exchanged with the other authorised stations only. And these amateur stations are forbidden to communicate with the countries which are not recognised by the International Telecommunication Union (ITU) and message like reproduction of broadcasting programmes, transmissions of entertainment values or music. Speeches which are offensive and which are likely to arouse racial, religious or communal animosities are prohibited.

As it is open channel communication privacy is not maintained. Call sign is of five to six characters. The first part indicates the name of the country from which the operator is working and the later part represents his name or code.

Ex: VU3RUV, KB1VTQ.

Before we establish a contact with other station on radio telephony, the following procedure should be followed.

1. If other station is giving a CQ (calling any station) call then we should immediately tune the transmitter to that frequency and answer when the calling station gives the invitation to transmitter.
2. If the other station is in communication with another, we should break call i.e. when one station is at the end of its transmission we announce our call sign indicating we are on that frequency and we should transmit only when we are asked to do so.
3. If we want to give general call to all stations then send CQ for a period of not more than one minute which we should transmit THIS IS (call sign). This procedure may be repeated but should not exceed three minutes after which one should listen out in the band for some time.
4. Letters of the call sign maybe pronounced phonetically.

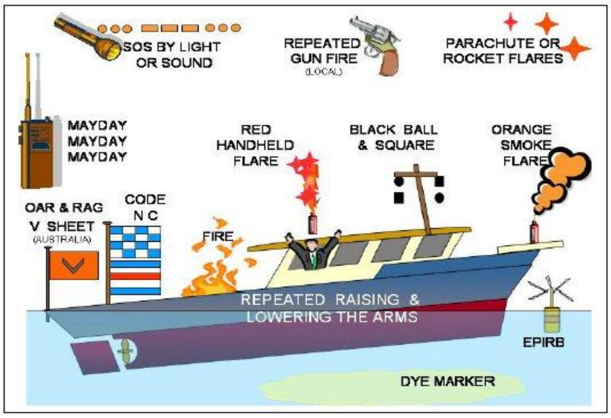
A. STANDARD FREQUENCIES AND TIME SIGNALS

In India National Physical laboratories whose call signal is ATA transmits time signal for every fifteen minutes by an announcement in A3E emission declaring the IST along with their frequency accuracy of such transmission will be of the order as 1 in 10^{11}.

B. DISTRESS SIGNAL

Radio Telegraph uses a group of ‘SOS’ signals and Radio Telephone uses the word ‘MAYDAY’ as its distress signal. This distress signal indicates that a ship or vehicle is threatened by a grave and imminent danger and request for it immediate assistance.

The distress signal shall have absolute priority over all other transmissions. All Stations which hear it shall cease any transmissions which are capable of interfering with the distress traffic and will continue to listen on the frequency used for the transmission of distressed call.



International distress signals.

C. URGENCY SIGNAL

Radio Telegraphy uses three repetitions of the group ‘XXX’ signals sent with the letters of each group and successive group clearly separated from each other as its urgency signal.

In Radio Telephony uses the group of words ‘PANPAN’ as its urgency signal. The urgency signal indicates urgent message to transmit, concerning safety of a person in critical situation. These signals have priority over all other communications except distress.

D. TEST SIGNAL

It is necessary to make test signals either for adjustment of transceiver or any experiment; such signals should not be continued for more than 30seconds and shall be composed of series of VVV’s in Radio Telegraphy and 1,2,3,4 spoken in figure code in Radio Telephony.

E. EMISSIONS USED RADIO COMMUNICATION

A1A

Signaling by keying the carrier directly CW or on/ off Keying currently used in Amateur Radio. This is often but not necessarily Morse code.

A2A

Signaling by keying a tone modulated onto a carrier so that it can easily be heard using an ordinary AM receiver - as previously used for station indents of some RDF transmissions. This is usually but not exclusively Morse code.

A3E

AM speech communication - as used for Aeronautical VHF communications.

F3E

FM speech communication - as used for Marine and many other VHF communications.

N0N

Continuous, unmodulated carrier - as previously commonly used for radio direction finding (RDF) in marine and aeronautical navigation.

J3E

SSB speech communication - as used on HF bands by marine, aeronautical and amateur users

A3E or A3EG

Normal AM broadcast - as found on MW radio

F1B

FSK telegraphy, such as RTTY

F8E or F8EH

Normal FM stereo broadcast - as found on VHF FM band

F. FREQUENCY BAND SPECTRUMS FOR HAM RADIO

Frequencies are allocated based on the DC input power input specified by a HAM based on the Grade or Class of Examination he passed or opted.

Restricted Grade contains a power input of 10 watts and 50watts where Morse code is exempted and General Grade contains a power input of 25 watts and 400 watts where Morse code is required.

TABLE I. TABLE SHOWING THE FREQUENCIES ALLOCATED TO CLASS A& CLASS B

Class A privilege

Frequency Bands (in MHz)	Maximum Power Level (in Watts PEP)	Classes of Emission
1.8 - 2.0	25	A1A, A2A, A3E, F1A, F2A, F3E, J3E, R3E,
3.5 - 3.9	400	
7.0 - 7.1	400	
10.1 - 10.15	400	
14.0 - 14.35	400	
18.068 - 18.168	400	
21.0 - 21.45	400	
24.89 - 24.99	400	
28.0 - 29.7	400	
50.0 - 54.0	400	
144.0 - 146.0	400	
146.0 - 148.0	400	
430.0 - 440.0	100	
1,240 - 1,300	100	A1A, A2A, A3E, A3C, C3F, F1A, F2A, F3E, J3E, R3E
2,300 - 2,450	50	
3,300 - 3,500	50	
5,650 - 5,850	50	
10,000 - 10,500	50	
24,000 - 24,250	50	
47,000 - 47,200	50	
75,500 - 81,000	50	
119,980 - 120,020	25	
142,000 - 144,000	25	
144,000 - 149,000	25	
244,000 - 248,000	25	
248,000 - 250,000	25	

Class B privilege

Frequency Bands (in MHz)	Maximum Power Level (in Watts PEP)	Classes of Emission
28.0 - 29.7	50	A3E, F1A, F2A, F3E, J3E, R3E,
50.0 - 54.0	50	
144.0 - 146.0	50	
146.0 - 148.0	50	
430.0 - 440.0	50	

G. Q CODES

Q code is a standardized collection of three-letter message encodings, also known as a brevity code, all of which start with the letter "Q", initially developed for commercial radiotelegraph communication, and later adopted by other radio services, especially amateur radio. Although Q codes were created when radio used Morse code exclusively, they continued to be employed after the introduction of voice transmissions. To avoid confusion, transmitter call signs are restricted; while an embedded three-letter Q sequence may occur (for instance when requested by an amateur radio station dedicated to low-power operation), no country is ever issued an ITU prefix starting with "Q". The codes in the range QAA–QNZ are reserved for aeronautical use; QOA–QQZ for maritime use and QRA–QUZ for all services.

Selected Q codes were soon adopted by amateur radio operators. In December, 1915, the American Radio Relay League began publication of a magazine titled *QST*, named after the Q code for "General call to all stations". In amateur radio, the Q codes were originally used in Morse code transmissions to shorten lengthy phrases and were followed by a Morse code question mark (••--••) if the phrase was a question.

Ham Radio Q Signals

Amateur ham radio operators use Q signals (or Q codes) as shorthand to speed up non-voice communication. Each Q signal represents information: advice, an answer, or a call for action. You turn the signal into a question by adding a question mark right after the Q signal. This list of common Q signals shows the meanings of the codes as they'd appear with and without a question mark:

Q Signal	Meaning
QRL	Is the frequency busy? The frequency is busy. Please do not interfere.
QRM	Abbreviation for interference from other signals.
QRN	Abbreviation for interference from natural or man-made static.
QRO	Shall I increase power? Increase power.
QRP	Shall I decrease power? Decrease power.
QRQ	Shall I send faster? Send faster (WPM).
QRS	Shall I send more slowly? Send more slowly (__WPM).
QRT	Shall I stop sending? Stop sending.
QRU	Have you anything more for me? I have nothing more for you.
QRV	Are you ready? I am ready.
QRX	Standby.
QRZ	Who is calling me?
QSB	Abbreviation for signal fading.
QSL	Received and understood.
QSO	Abbreviation for a contact.
QST	General call preceding a message addressed to all amateurs.
QSX	I am listening on ___ kHz.
QSY	Change to transmission on another frequency (or to ___ kHz).
QTH	What is your location? My location is ____.

Figure 12. List of HAM Radio Q Signals

H. INTERNATIONAL PHONETIC ALPHABETS

Letter and numeral pronunciation can be so easily misunderstood (such as hearing an "S" for an "F" or a "B" for a "D"). Because of that, letters and numerals in aviation are spoken using the International Phonetic Alphabet. This alphabet substitutes an entire word to represent one letter. The first letter of the word is the letter of the alphabet it represents. It would be difficult to confuse "Sierra" (the letter "S") for the letter "F" (said as "Foxtrot"). The numeral "nine" is pronounced "niner." The accepted reasoning is that "nein" is a common German word that means no. By eliminating that pronunciation, confusion was to be avoided.

International Phonetic Alphabet

A	•—	Alpha	N	—•	November
B	—•••	Bravo	O	———	Oscar
C	—•—•	Charlie	P	•——•	Papa
D	—••	Delta	Q	——•—	Quebec
E	•	Echo	R	•—•	Romeo
F	••—•	Foxtrot	S	•••	Sierra
G	——•	Golf	T	—	Tango
H	••••	Hotel	U	••—	Uniform
I	••	India	V	•••—	Victor
J	•———	Juliet	W	•——	Whiskey
K	—•—	Kilo	X	—••—	X-ray
L	•—••	Lima	Y	—•——	Yankee
M	——	Mike	Z	——••	Zulu

Figure 13. International Phonetic Alphabets

V. CONCLUSION

Disasters are untimed, unprecedented and sudden occurrences which disturbs the peaceful environment. Though mild ones like heavy rains are withstood by the living ones but severe disasters like tsunamis, earthquakes, hurricanes, cyclones and volcanic eruptions do not allow living ones survival.

Hence it is the time for proper communication to bring down the severity of the loss. The above mentioned procedure can be useful even if the power failures occur (i.e. they can be used by a battery) to send proper messages for rescue operations. The above mentioned procedures are thoroughly followed only by the licensed authorities who are willing to render their services to mankind without any profits.

This paper has mentioned the effective construction and communicative procedures for an amateur to enter into the world of HAM.

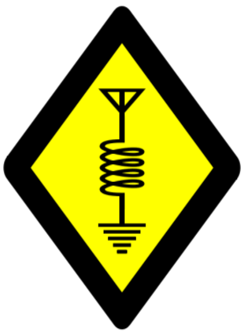


Figure 14. Symbol of InternationalAmateur Radio

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